

## **EOSDIS Core System Project**

# **Developed Software Maintenance Plan for the ECS Project**

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May 1996

Hughes Information Technology Systems  
Upper Marlboro, Maryland

# **Developed Software Maintenance Plan for the ECS Project**

**May 1996**

Prepared Under Contract NAS5-60000  
CDRL Item 120

## **APPROVED BY**

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EOSDIS Core System Project	

**Hughes Information Technology Systems**  
Upper Marlboro, Maryland

614-CD-001-003

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# Preface

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This document, as a formal contract deliverable with an approval code 1, required Government review and approval prior to acceptance and use. It was reviewed and approved, with comments, per GSFC Code 505 contracts letter dated August 31, 1995. Comments received with the approval letter have been incorporated, and this document is now considered accepted for use; no further review is required. Future changes to this document shall be made by document change notice (DCN) or by complete revision. Any future changes must be reviewed and approved by the Government.

For additional technical information pertaining to this document, contact Rodney Creecy, M&O, at 301-925-0314 or on email at [rodney@eos.hitc.com](mailto:rodney@eos.hitc.com).

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# Abstract

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This Developed Software Maintenance Plan (DID 614/OP1) addresses the life cycle maintenance concept and the related responsibilities of the ECS Project for the developed software products supplied by the ECS Contractor. It describes policies and procedures for maintenance activities. It specifies the records to document problems and associated resolutions; reports to be provided; procedures for Configuration Control; training requirements; and procedures for maintaining visibility and control of system problems using Trouble Tickets tracked by the Failure Review Board. The Plan addresses M&O regression testing to verify the results of major maintenance activity. The period of responsibility is stated as are the responsibilities of third-party contractors. This plan identifies the maintenance site locations, hours of support and levels of support.

**Keywords:** Maintenance, principal period of maintenance, local maintenance coordinator, ILS Maintenance Coordinator, Sustaining Engineering, Independent Verification and Validation, diagnostics, escalation procedures, operational availability, regression testing, M&O, Distributed Active Archive Center, DAAC, On-Site, System Monitoring and Coordination Center, SMC, EOS Operations Center (EOC), Trouble Ticket (TT), Sustaining Engineering Office (SEO), Integrated Logistics Support. (ILS)

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## Abbreviations and Acronyms

# 1. Introduction

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## 1.1 Identification

This document, Contract Data Requirements List (CDRL) Item 120, whose requirements are specified in Data Item Description (DID) 614/OP1, is a required deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract (NAS5-6000).

## 1.2 Scope

This document applies to all developed software supplied by the ECS Contractor. It defines the responsibilities of the ECS Project organization for the maintenance of developed software products at the Distributed Active Archive Centers (DAACs), EOS Operations Center (EOC), System Monitoring and Coordination Center (SMC), and coordination with the ECS Development Facility (EDF). This document lays the foundation for performing and managing the developed software maintenance for the ECS. Generally stated, developed software maintenance entails acceptance and integration of on-site maintenance changes to ECS software; to produce, deliver, and document system-wide corrections, modifications, and enhancements made to ECS software; and/or to adapt or incorporate any software for ECS use. Software configuration management is only discussed as it relates to software maintenance problem resolution, version/update, and change control.

The maintenance of science software and data items provided by the Science Computing Facilities (SCFs) is not the responsibility of the ECS on-site maintenance engineers. Problem resolutions and changes to science software sponsored by the SCFs shall be introduced under the auspices of local DAAC configuration management activities and the Earth Science Data and Information System (ESDIS) (GSFC Code 505) CCB in the same manner as new releases to baselined science software. On-site changes or updates shall be integrated and tested by the Science Software Team. Ongoing CM of ECS integrated science software will be accomplished by the same tool set used for ECS developed software as explained in Section 3.3 Standardization of Support Procedures under local DAAC control.

## 1.3 Purpose

This document describes the general concept and plan for maintaining developed software in support of ECS objectives. This plan is applicable to maintenance support of ECS developed software from initial product installation until maintenance responsibility is transferred to NASA or its designated follow-on maintenance contractor. This document describes the responsibilities of the ECS contractor in providing developed software maintenance support to the ECS project.

## **1.4 Status and Schedule**

Updates to this plan will be completed 2 weeks prior to the Increment Design Review (IDR) and the CDR to be held for Releases B, C, and D. Updates may also be required for unplanned changes in the scope of the Maintenance and Operations program. Changes will be recorded in change pages located at the front of this plan. This plan may be reissued whenever the number of changed pages makes it more efficient and economical to do so. The distribution of a reissued plan and changes to the plan will be sent in the same quantities and to the same organizations that received the initial Developed Software Maintenance Plan.

## **1.5 Organization**

The contents of this document are organized as follows:

- Section 1: Introduction - Introduces the Developed Software Maintenance Plan scope, purpose, status and schedule, and document organization
- Section 2: Related Documentation - Describes the parent, reference, and applicable documents useful in understanding the details of subjects discussed in this document.
- Section 3: System Description - Describes the ECS conceptual architecture, operation and maintenance, standardization of procedures, and supporting environmental and facility requirements.
- Section 4: Technical Approach - Describes the maintenance objectives; organizational roles, responsibilities, and resources; maintenance approach; relationship of developed software and COTS software maintenance activities; maintenance problem resolution; problem resolution escalation procedures; maintenance evaluation and reporting; and Government Furnished Software.

## 2. Related Documentation

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### 2.1 Parent Documents

The parent documents are the documents from which this Maintenance Plan's scope and content are derived.

102-CD-001-004	Development Configuration Management Plan for the ECS Project, Revision 1
102-CD-002-001	Maintenance and Operations Configuration Management Plan for the ECS Project
420-05-03	Goddard Space Flight Center, Earth Observing System (EOS) Performance Assurance Requirements for the EOSDIS Core System (ECS)
423-41-01	Goddard Space Flight Center, EOSDIS Core System (ECS) Statement of Work
423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System (ECS)

### 2.2 Applicable Documents

The following documents are referenced within this Maintenance Plan or are directly applicable, or contain policies or other directive matters that are binding upon the content of this document.

301-CD-002-003	System Implementation Plan for the ECS Project
STDN 402	Goddard Space Flight Center, NASA System Maintenance Program
500-SMP	Goddard Space Flight Center, Mission Operations and Data Systems Directorate Systems Management Policy
500-TIP-2110	Goddard Space Flight Center, Mission Operations and Data Systems Directorate (MO&DSD) Technical Information Program (TIP) Specifications for Document Formats

### 2.3 Information Documents

The following documents are referenced herein and, amplify or clarify the information presented in this document. These documents are not binding on the content of this Maintenance Plan.

193-103-MG3-001	Configuration Management Procedures for the ECS Project
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108-CD-000-XXX	Intermediate Logic Network Diagrams for the ECS Project
194-201-SE1-001	ECS Systems Engineering Plan for the ECS Project
194-207-SE1-001	System Design Specification for the ECS Project
194-302-DV1-001	ECS Facilities Plan for the ECS Project
302-CD-002-001	SDPS/CSMS Release A and FOS Release A and B Facilities Plan for the ECS Project
101-303-DV1-001	Individual Facility Requirements for the ECS Project
305-CD-002-002	Science Data Processing Segment (SDPS) Design Specification for the ECS Project
305-CD-003-002	Communications and System Management (CSMS) Design Specification for the ECS Project
305-CD-004-001	Overview of Release A SDPS and CSMS System Design Specification for the ECS Project
305-CD-005-001	Release A SDPS Client Subsystem Design Specification for the ECS Project
305-CD-006-001	Release A SDPS Interoperability Subsystem Design Specification for the ECS Project
305-CD-007-001	Release A SDPS Data Management Subsystem Design Specification for the ECS Project
305-CD-008-001	Release A SDPS Data Server Subsystem Design Specification for the ECS Project
305-CD-009-001	Release A SDPS Ingest Subsystem Design Specification [for the ECS Project]
305-CD-010-001	Release A SDPS Planning Subsystem Design Specification for the ECS Project
305-CD-011-001	Release A SDPS Data Processing Subsystem Design Specification for the ECS Project
305-CD-012-001	Release A CSMS Communications Subsystem Design Specification for the ECS Project
305-CD-013-001	Release A CSMS Systems Management Subsystem Design Specification for the ECS Project
305-CD-014-001	Release A GSFC DAAC Design Specification for the ECS Project
305-CD-015-001	Release A LaRC DAAC Design Specification for the ECS Project

305-CD-016-001	Release A MSFC DAAC Design Specification for the ECS Project
305-CD-017-001	Release A EDC DAAC Design Specification for the ECS Project
305-CD-018-001	Release A Data Dictionary for Subsystem Design Specification for the ECS Project
305-CD-019-001	Release A System Monitoring and Coordination Center Design Specification for the ECS Project
305-CD-020-002	Release B SDPS/CSMS Design Overview Specification for the ECS Project
305-CD-021-002	Release B SDPS Client Subsystem Design Specification for the ECS Project
305-CD-022-002	Release B SDPS Interoperability Subsystem Design Specification for the ECS Project
305-CD-023-002	Release B SDPS Data Management Subsystem Design Specification for the ECS Project
305-CD-024-002	Release B SDPS Data Server Subsystem Design Specification for the ECS Project
305-CD-025-002	Release B SDPS Ingest Subsystem Design Specification for the ECS Project
305-CD-026-002	Release B SDPS Planning Subsystem Design Specification for the ECS Project
305-CD-027-002	Release B SDPS Data Processing Subsystem Design Specification for the ECS Project
305-CD-028-002	Release B CSMS Communications Subsystem Design Specification for the ECS Project
305-CD-029-002	Release B CSMS System Management Subsystem Design Specification for the ECS Project
305-CD-030-002	Release B GSFC DAAC Design Specification for the ECS Project
305-CD-031-002	Release B LaRC DAAC Design Specification for the ECS Project
305-CD-032-001	Release B MSFC DAAC Design Specification for the ECS Project
305-CD-033-002	Release B EDC DAAC Design Specification for the ECS Project
305-CD-034-002	Release B ASF DAAC Design Specification for the ECS Project



305-CD-035-002	Release B NSIDC DAAC Design Specification for the ECS Project
305-CD-036-002	Release B JPL PO.DAAC Design Specification for the ECS Project
305-CD-037-002	Release B ORNL DAAC Design Specification for the ECS Project
305-CD-038-002	Release B System Monitoring and Coordination Center (SMC) Design Specification for the ECS Project
305-CD-039-002	Release B Data Dictionary for the ECS Project Subsystem Design Specification
305-CD-040-001	Flight Operations Segment (FOS) Design Specification for the ECS Project (Segment Level Design) Overview
305-CD-041-001	Flight Operations Segment (FOS) Planning and Scheduling Design Specification for the ECS Project
305-CD-042-001	Flight Operations Segment (FOS) Command Management Design Specification for the ECS Project
305-CD-043-001	Flight Operations Segment (FOS) Resource Management Design Specification for the ECS Project
305-CD-044-001	Flight Operations Segment (FOS) Telemetry Design Specification for the ECS Project
305-CD-045-001	Flight Operations Segment (FOS) Command Design Specification for the ECS Project
305-CD-046-001	Flight Operations Segment (FOS) Real-Time Contact Management Design Specification for the ECS Project
305-CD-047-001	Flight Operations Segment (FOS) Analysis Design Specification for the ECS Project
305-CD-048-001	Flight Operations Segment (FOS) User Interface Design Specification for the ECS Project
305-CD-049-001	Flight Operations Segment (FOS) Data Management Design Specification for the ECS Project
307-CD-001-003 329-CD-001-003	Flight Operations Segment (FOS) Release Plan and Development Plan for the ECS Project
307-CD-002-002 329-CD-002-002	Science Data Processing Segment (SDPS) Release and Development Plan for the ECS Project
307-CD-003-003 329-CD-003-003	Communications and System Management Segment Release and Development Plan for the ECS Project

307-CD-004-001 329-CD-004-001	Release B Science Data Processing Segment (SDPS) Release and Development Plan for the ECS Project
307-CD-005-001 329-CD-005-001	Release B Communications and System Management Segment (CSMS) Release and Development Plan for the ECS Project
308-CD-001-005	Software Development Plan for the ECS Project
194-415-VE1-002	Acceptance Testing Management Plan for the ECS Project
501-CD-001-004	Performance Assurance Implementation Plan (PAIP) for the ECS Project
601-CD-001-004	Maintenance and Operations Management Plan for the ECS Project
194-602-OP1-001	Property Management Plan for the ECS Project
604-CD-001-004	ECS Operations Concept for the ECS Project: Part 1-- ECS Overview
604-CD-002-003	Operations Concept for the ECS Project: Part 2B -- ECS Release B
604-CD-003-001	Operations Concept for the ECS Project: Part 2A -- ECS Release A
604-CD-004-001	ECS Operations Concept for the ECS Project: Part 2 -- FOS
605-CD-001-003	Operations Scenarios for the ECS Project: ECS Release A
605-CD-002-001	Release B SDPS/CSMS Operations Scenarios for the ECS Project
605-CD-003-001	Operations Scenario Document for the ECS Flight Operations Segment (FOS)
607-CD-001-002	ECS Maintenance & Operations Positions Descriptions for the ECS Project
608-CD-001-002	ECS Operations Plan for Release B
611-CD-001-001	Interim Release 1 (Ir1) Operator's Manual for the ECS Project
616-CD-001-002	Release A Integrated Logistics Support Plan for the ECS Project
616-CD-002-001	Release B Integrated Support Plan for the ECS Project
622-CD-001-002	Training Plan for the ECS Project
222-TP-003-008	Release Plan Content Description for the ECS Project
CSC/TM-94/6024R0UD0	Goddard Space Flight Center, ESDIS Configuration Management Plan, October 1995 Draft

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## 3. System Description

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### 3.1 System to be Supported

The Earth Observing System (EOS) Data and Information System (EOSDIS), as the National Aeronautics and Space Administration's (NASA's) overall Earth Science discipline data system, provides the ground system for the collection and analysis of science data to support scientists in resolving the dynamics of the Earth's components and the processes by which they interact. As a part of the EOS Program, EOSDIS supports: the planning, scheduling, and control of the EOS series of spacecraft; exchanging commands, data and algorithms with the European Space Agency (ESA), Japan, Canada, the National Oceanic and Atmospheric Administration (NOAA), and any other non-NASA entities involved in the overall EOS mission; the coordination of these activities with other data gathering systems; and the transformation of the observations into physical variables, providing for higher levels of processing and presenting the data to users in forms that facilitate and stimulate interactive scientific research. The portion of EOSDIS addressed in this document is the EOSDIS Core System (ECS).

The ECS is the geographically distributed ground system network for the collection, processing, storage, retrieving, and distribution of data obtained from space platforms and other sources. ECS also supports the operation and management of the EOS in-orbit payloads. The ECS is designed to be an expandable, technology adaptable, modular hierarchy of segments, elements, and subsystems.

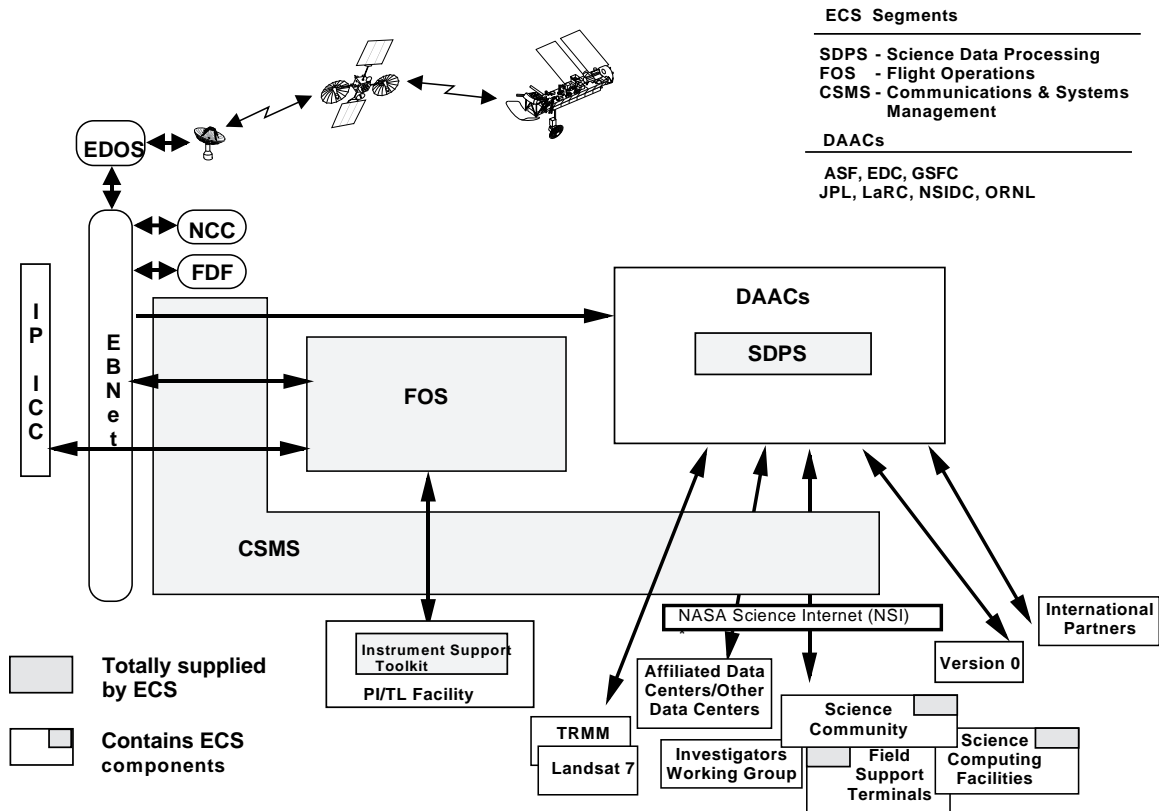
#### 3.1.1 Functions of ECS Segments

The ECS has three segments: The Flight Operations Segment (FOS), the Science Data Processing Segment (SDPS), and the Communications and Systems Management Segment (CSMS). Each segment has unique functions and availability requirements. The ECS, with its components and interfaces, is depicted in Figure 3-1, "ECS Conceptual Architecture."

The FOS is composed of two elements that manage and control the EOS-AM1 space platform and instruments. These elements are the EOS Operations Center (EOC) and the Instrument Support Toolkits (ISTs). The EOC is responsible for monitoring and control of all instruments on-board U.S. EOS spacecraft while the IST (a software product) provides Principle Investigators and Team Leaders access to the EOC functions although they may not be physically at the EOC.

The SDPS consists of seven subsystems: Client, interoperability, data management, data server, ingest, planning and data processing. Together, these subsystems support the services required to receive, process, archive, distribute and manage the NASA Probe flight missions, EOS-AM1 space platform and instruments, other selected remotely sensed data, and associated data products.

The CSMS consists of 3 subsystems: 1) The Communications Subsystem (CSS) which is a collection of services providing flexible interoperability and information transfer between clients and servers; 2) The Internetworking Subsystem (ISS) which is the layered stack of communications services consisting of the data link and physical services, the network services, and the transport services; and 3) The System Management Subsystem (MSS) which is a collection of applications that manages all ECS resources. Using these functions, the SMC will monitor and coordinate the operations of the ground system resources, facilities and communications network and interfaces to NASA's communications system(s).



**Figure 3-1. ECS Conceptual Architecture**

### 3.1.2 ECS Release Missions to be Supported

The ECS will be delivered in four Releases (A to D) and an Interim Release (IR-1). The four Releases (A to D) support the missions shown below in table 3.1-1 which reflects changes per ESDIS CCR 505-01-41-073-A. IR-1 is an early release of the ECS to support early Tropical Rainfall Measuring Mission (joint US-Japan mission a.k.a. TRMM) interface testing. Developers support and maintain IR-1 developed software because that release does not support an operational mission. Details of the release cycle are reflected in the Release schedules presented in Section 13 of the Release Plan (222-TP-003-005). Developed software maintenance activity begins following Release Readiness Review (RRR) for each release.

**Table 3.1-1. Release Missions**

<b>Release</b>	<b>Mission(s) Supported</b>
Interim Release 1	TRMM Testing, Early Interface Testing
Release A	TRMM Mission; Landsat 7 Early Interface Testing; EOS AM-1 Interface Testing, Data Flow Testing and Simulation Readiness Testing
Release B	EOS AM-1 (ASTER, CERES, MISR, MODIS and MOPITT instruments); LANDSAT-7 (ETM+ instrument); Flight of Opportunity (COLOR instrument); METEOR (SAGE III instrument); RADAR ALT (DFA & MR instruments); Flight of Opportunity (ACRIM instrument); ADEOS II (SeaWindS instrument); and ERS1/2, JERS1, and RADARSAT SAR at ASF
Release C*	FOO (CERES); EOS PM-1 [AIRS, AMSU, CERES, MIMR, MODIS, MHS (NOAA)]; and Space Station (SAGE III)
Release D*	EOS CHEM-1 (HIRDLS, MLS, CII, TES) and LASER ALT (GLAS)

\*Evolutionary Enhancements

Note that Release A serves the dual purpose of supporting the TRMM mission and it provides sufficient capability to support EOS AM-1 testing.

### **3.1.3 ECS Locations**

This document is based on the ECS Change Order 1 list of locations and Statement of Work. Therefore, the development of ECS results in the deployment of ECS systems and subsystems to the institutions shown below:

- Distributed Active Archive Centers (DAACs):
  - Alaska SAR Facility (ASF) — University of Alaska - Fairbanks, Alaska
  - EROS Data Center (EDC) — Sioux Falls, South Dakota
  - Goddard Space Flight Center (GSFC) — Greenbelt, Maryland
  - Jet Propulsion Laboratory (JPL) — Pasadena, California
  - Langley Research Center (LaRC) — Hampton, Virginia
  - National Snow and Ice Data Center (NSIDC) — University of Colorado, Boulder, Colorado
  - Oak Ridge National Laboratory (ORNL) — Oak Ridge, Tennessee
- System Monitoring and Coordination Center (SMC) — GSFC Building 32
- EOS Operations Center (EOC) — GSFC Building 32
- ECS Sustaining Engineering Office (SEO) — GSFC Building 32

This plan addresses maintenance of the developed software of ECS deployed to these locations.

## **3.2 Mapping Developed Software Maintenance Requirements to Subsystems**

The developed software maintenance requirements can be best visualized through the planned releases as described in Section 3.1.2 at the locations described in Section 3.1.3 and the maintenance requirements for specific configuration items per subsystem as described in Subsections 3.2.1 through 3.2.3. Developed software maintenance entails acceptance and integration of on-site maintenance changes to ECS software; production, delivery, and documentation of system-wide corrections, modifications, and enhancements made to ECS software; and/or adaptation or incorporation of any software for ECS use.

This plan was prepared in the same context that the product to be maintained is itself being defined. ECS maintenance requirements will be documented in the ECS product specifications. Maintenance procedures (611-CD-001-001) will be defined to detail the implementation of maintenance requirements derived from the ECS product specifications referenced in Subsections 3.2.1 through 3.2.3.

### **3.2.1 Mapping of SDPS Architecture to Releases**

The SDPS consists of seven software subsystems/CSCIs: client, interoperability, data management, data server, ingest, planning and data processing. The specifications of these subsystems and their associated object (service) classes are described in SDPS Release Plans (307-CD-002-002) and SDPS Design Specification (305-CD-tbd).

### **3.2.2 Mapping of FOS Architecture to Releases**

The FOS consists of eight software subsystems/CSCIs: planning and scheduling, command management, command, telemetry processing, spacecraft and instrument analysis, data management, resource management and user interface. The specifications of these subsystems and their associated object (service) classes are described in FOS Release Plans (307-CD-001-002) and FOS Design Specification (305-CD-tbd).

### **3.2.3 Mapping of CSMS Architecture to Releases**

The CSMS consists of six Computer Software Configuration Items (CSCIs): distributed computing, network management, network, agent, system management and management logistics. The specifications of these CSCIs and their associated object (service) classes are described in CSMS Release Plans (307-CD-003-002) and CSMS Design Specification (305-CD-tbd).

## **3.3 Standardization of Support Procedures**

The use of the configuration management tool set as discussed in the M&O Configuration Management section of the ECS Configuration Management Plan will enable the standardization of the software maintenance procedures using:

- a. Tools from the Management Logistics configuration item which contains the:
  1. **SW CM Manager (ClearCase (TM))**-- Used to record, report, and manage changes to custom ECS SW, science SW, and data base control files. Used to perform SW builds and compiles and to distribute ECS custom SW and science SW.
  2. **Baseline Manager**-- Used to record and report the as-built operational baseline of ECS products. Contains the configuration record for each baselined product. Identifies products by CI number, description, location, model/version, and component configured articles. Provides traceability to previous configurations.
  3. **Change Request Manager**-- Used to record and manage proposed and approved Configuration Change Requests (CCRs) related to ECS operations baselines.
  4. **Document Data Server Subsystem**-- Used to manage documents related to the operational baseline, including requirements, design, product documents, and baselined operations plans and procedures. Baselined ECS documents will be entered into and controlled at sites and at the system-level using a combination of word processors.
- b. Tools from the Management Software configuration item which contains the:
  1. **Trouble Ticket System (TTS)**-- The TTS is a tool used at the DAACs, SMC, and EOC to record and report problems. It records events, work-off assignments, and actions taken (controlled-baseline configuration changes must be documented in CCRs and approved by the DAAC/EOC/SMC CCB).

These tools are data bases, libraries, SW tools, and the related procedures for the management of configuration items (CIs), processing change requests, management of the CI documentation, and problem reporting and resolution. These tools will be delivered and implemented with the ECS product at RRR.

The M&O organization prepares and executes the installation plans for the operational facilities. These installation plans include site-specific installation requirements and applicable site policies and codes. The M&O organization is responsible for assuring that each site is ready to receive each release/change order from ECS. They are responsible for managing, controlling, and maintaining the ECS software configuration at each site. For more detailed information concerning the general support procedures to be performed during the M&O phase, refer to the Maintenance and Operations Management Plan (MOMP) for the ECS Project (601-CD-001-001).

The M&O Management Plan has numerous references to plans and procedures derived from various resources including the ECS developers, M&O, and site-level organizations. Specific policies, practices, and procedures are referenced at Section 2.3.4 and 2.3.5 and Section 6 gives a general discussion of Policies, Procedures and Documentation for management systems, personnel, and site/center policies. ESDIS will be responsible for implementing standard policies and procedures with the technical support of the Sustaining Engineering Office (SEO).



The standardization of policies and procedures is a long-range objective that we are just laying the ground work to accomplish with the present plan. The operational procedures will evolve based on experience and user feedback. The procedures for handling feedback based on review of developed software and its operational use are as follows:

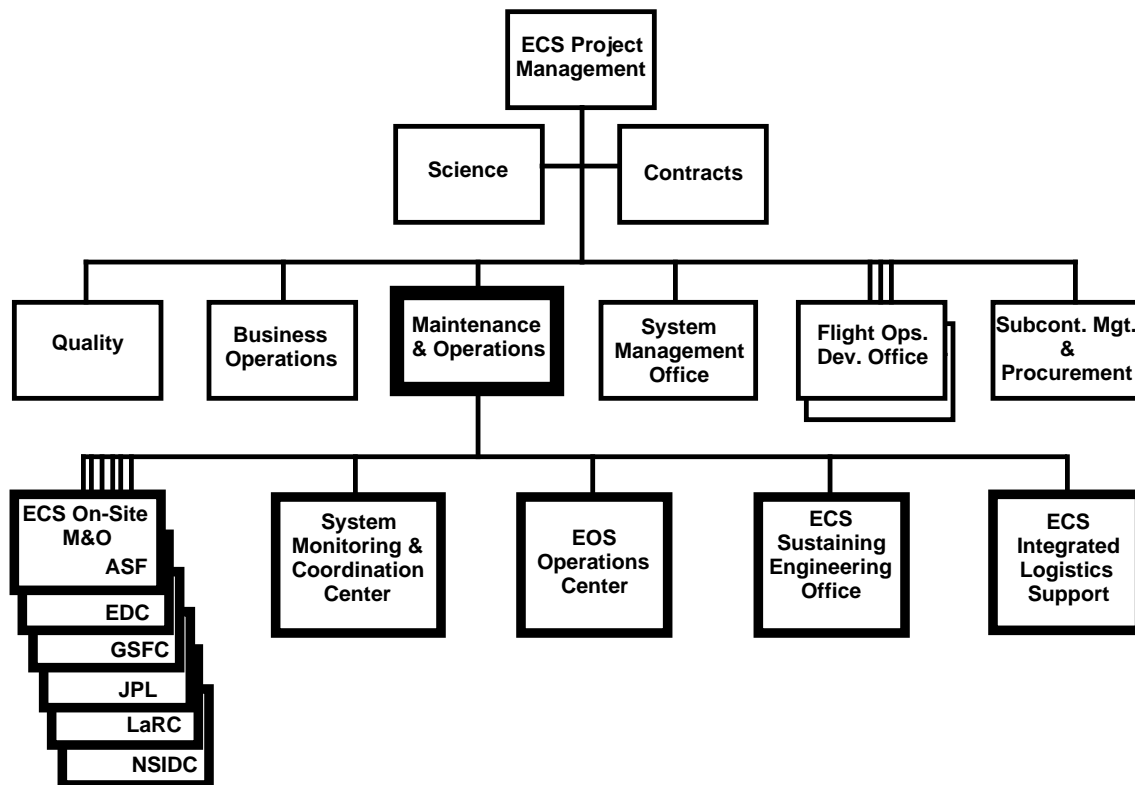
- a. The User Recommendations Database (URDB) is used to provide a focal point for collecting and tracking system recommendations. Recommendations from the user community are screened and assessed to understand the full scope of technical, schedule, and cost implications before submitting them to the Configuration Change Process as discussed in Section 4.3.2. Recommended requirements accepted by the appropriate Configuration Change Board are entered into the formal Configuration Change Process as discussed in Section 4.3.4. For more details, refer to the Software Development Handbook, 151-TD-001.
- b. During operations, ECS User Services at each DAAC will be available for reviewing further development ideas and recommending new capabilities or features throughout the planned releases. User Services are discussed in the MOMP at Section 3.2.
- c. At the beginning of a release, feedback based on operational experience gained from the previous release is available for defining the requirements and scenarios which will drive formal development and serve to upgrade the system in the subsequent release. However, Operations feedback to developers is a continuing activity via formal and informal discussions, viz., telecons, surveys of user groups, Discrepancy Reporting, Configuration Change Requests, documentation review, and ECS program reviews in coordination with the SEO.

Incorporation of lessons-learned from field experience will help software maintenance as well as developers. This process will be further aided by the use of surveys and problem tracking conducted by M&O staff and coordinated by SEO.

## 4. Technical Approach

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The ECS organization, shown in Figure 4-1, provides maintenance and operations for ECS hardware, software, and firmware systems delivered under the ECS contract at the ECS sites. The functions performed by each of the M&O organizations are described in the M&O Management Plan (601-CD-001-001).



**Figure 4-1. ECS M&O Organization**

In general, ECS organizations produce, deliver, and document the corrections, modifications, adaptations and enhancements made to ECS software, firmware, and hardware. No custom firmware has been identified to be part of the ECS program. Commercial Off-The-Shelf software (SW), firmware, and hardware will be maintained in accordance with the COTS Maintenance Plan (613-CD-001-001). The Project maintenance philosophy for software is to provide ECS centralized support for developed items and vendor directed support for COTS. Specific developed SW support requirements will be discussed from a functional basis in this document. Staffing requirements are

discussed in the ECS Operations Plan (608-CD-001-002). Training is discussed in the ECS Training Plan (622-CD-tbd, delivered at the SCDO & FOS CDR, and later at the Release B IDR). Specific schedules of programmed activities are contained in the Intermediate Logic Network Diagrams (108-CD-tbd).

Developed SW maintenance includes:

- Resources, including equipment, software tools and personnel to maintain ECS in accordance with specified functional, performance, and availability requirements.
- Services required to produce, deliver, integrate, install, test, validate and document corrections and modifications of existing ECS software and firmware. The maintenance activity includes: software configuration management (CM) including support for change control, configuration status accounting, and audit activities and software quality assurance (QA). Each site is the CM authority over its own resources subject to ESDIS delegation of roles for ECS management.

The following sections provide additional information.

## **4.1 Maintenance Objectives**

In general, maintenance of developed SW CIs is performed within the bounds of the allocated requirements baseline. Changes resulting from new or modified requirements are considered developmental changes rather than maintenance, regardless of the organization that performs them. COTS modifications that are not part of vendor provided options, i.e., customization, and interface to developed code modules are addressed by this Developed SW Maintenance Plan document. COTS upgrades are covered by the COTS Maintenance Plan. We will add information relative to glue code maintenance in coordination with the release of the ECS product specifications.

The objectives of the software maintenance are to provide, in a prioritized manner, four types of maintenance:

- Adaptive Maintenance (AdM) - performed to adapt SW to changes in the data or processing environments. Upgrades are performed to adapt changes in the processing environment including computers, storage and networks. AdM includes changes that support an evolving user mix and/or methods of access to ECS resources; changes driven by policy and procedural changes that govern ECS as a whole or at individual centers; and migration of a subsystem to a new computer host is another category of adaptive maintenance.
- Corrective Maintenance (CrM) - performed to identify and correct SW failures, performance failures, and implementation failures. Emergency repairs are performed when immediate repair is necessary to continue user service and/or operations. Corrective coding is performed to correctly reflect the specifications or to correctly utilize system resources. Removal of defects in design or implementation is an example of corrective maintenance.

- Perfective Maintenance (PfM) - performed to enhance performance, improve cost-effectiveness, improve processing efficiency, or improve maintainability. An example is the modification of an HMI or API to improve operations or users productivity.
- Preventive Maintenance (PvM) - performed to prevent or reduce the impacts of forecasted problems. Examples include reallocation of disk resources to support predicted changes in usage of short term storage, and maintenance of libraries at backup location(s).

Maintenance priorities will be codified by ESDIS and executed in terms of procedures and policy by the SEO following ECS mission requirements primarily and then to focus on local DAAC/EOC/SMC operational requirements. Establishment of maintenance priorities is an evolutionary process that can be optimized by on-going analysis of system SW being maintained.

The maintenance priorities will be determined in relation to the affect of a problem on mission success which shall be differentiated by scope of impact, frequency of occurrence, and the availability of an adequate work-around. Categories of problems will be determined in accordance with Performance Assurance Requirements document (NASA 420-05-03) criticality levels as follows:

- **1° Category 1: System/ Service cannot perform critical function or imposes major safety hazard.**
  - Presents an immediate impact to development , operations, services, or data processing functions; imposes major safety hazard to personnel, systems, or space mission resources; or results in loss of one or more essential mission objectives.
- **2° Category 2: System/ Service substantially impaired.**
  - Substantially impacts development, operations, services, or data processing functions; fails to operate within critical performance specifications; or cannot effectively or efficiently fulfill baseline requirements.
- **3° Category 3: System/ Service slightly impaired.**
  - Causes minor or no substantial impact to development, operations, services, or data processing functions. Support may be degraded, but mission can still be accomplished.

All level 1° problem reports will be elevated to the Government Failure Review Board and will require both Government and Contractor Project Manager approval for final close-out. SEO will also classify as:

- **4° Nuisance Problem** such as the arrangement of video screens, color, etc.
- **5° Closed Problem** is a known issue with a prior disposition.

The analysis of maintenance priorities should be based on a cumulative survey of SW performance parameters. The following information provides a basis for this analysis:

- a. Effort spent maintaining the SW during each year of its production life;
- b. SW age (based on when it was originally developed);
- c. Programming languages in which the SW was written;
- d. SW error information and correlation data (events, rate of occurrence, difficulty of correcting error condition, etc.);
- e. SW change information, indicating the number of changes requested and the difficulty of making the requested changes;
- f. User satisfaction survey, indicating whether the users feel the SW is useful or whether it is used at all;
- g. Maintenance programmer's effort to fix problem or implement a Change Control Request;
- h. Conformance of the SW to performance and/or data models;
- i. Difficulties of interfacing the SW with other systems because of lack of conformity; and
- j. Affect on mission success.

This information can be used to distinguish candidate SW for replacement, maintenance action, procedural change, etc. On the positive side, success profiles can also be generated to provide valuable feedback to the developers. No maintenance action should be taken without consultation related to the longterm planning and cost analysis impact assessment part of the change control process.

## **4.2 Roles, Responsibilities, and Resources**

The ECS Project maintenance philosophy for software is to provide ECS centralized support for developed items and application program interfaces (glue code) and vendor directed support for commercial-off-the-shelf (COTS). Specific developed SW support requirements are discussed in this document. Other referenced documents contain details that are not repeated here, viz.:

- Operations Scenarios (605-CD-002-001) discusses display formats and operations scenarios encountered in day-to-day operations and maintenance;
- Maintenance and Operations Manual (607-CD-001-003) discusses roles, responsibilities, and tools;
- ECS Operations Plan (608-CD-001-002) discusses staffing plan to implement the overall operations and maintenance concept; and
- Operator's Manuals (611-CD-001-001) discusses operations and maintenance procedures.

The planned centralized maintenance philosophy minimizes the extent and redundancy of the support requirements, e.g., changes or upgrades can be remotely maintained in some instances. The ECS Development Facility will have instances of every hardware suite used in the on-site locations for duplication of problems to be observed.

ECS M&O Office responsibilities for software maintenance begin at the following centers after the Release Readiness Review (RRR) for the Release A:

- EDC,
- GSFC,
- LaRC,
- SMC, and
- SEO.

ECS M&O responsibilities begin at the following locations between the TRMM Development Release RRR and the RRR for the Release B:

- EOC,
- ASF,
- JPL,
- ORNL<sup>1</sup>, and
- NSIDC.

The ECS Contractor has no M&O responsibilities at the Socio-Economic Data Applications Center (CIESIN).

#### **4.2.1 ECS Development Organizations**

The Flight Operations Office and the Science and Communications Development Office (SCDO) are the developmental arms of the ECS Contractor. Only SCDO provides SW maintenance functions for SW provided by:

- Evaluation Packages, and
- Interim Release-1 (IR-1).

Evaluation Packages are an early delivery mechanism that allow portions of ECS functionality to be placed into the hands of selected users for evaluation and design iteration in advance of formal system releases. As such, they help avoid late discovery that what has been produced is not that which is desired.

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<sup>1</sup>No on-site responsibilities, i.e., software updates only

The IR-1 Release is not a formal release. It is an early release to support early interface testing and algorithm integration and test. Acceptance testing is not performed on the Release, but it may be subject to IV&V. Therefore, the ECS Science and Communications Development Office (SCDO) retains baseline control and maintenance responsibilities of all SW until Release A RRR.

Maintenance of SW items in these two categories is performed in accordance with development organization policies and procedures.

#### **4.2.2 DAAC ECS On-Site Maintenance and Operations**

At each DAAC<sup>2</sup>, the ECS On-Site M&O organization provides personnel, tools, computational, storage and network resources for PvM actions on SDPS and CSMS SW CIs used in the operational environment that exists at the DAAC<sup>3</sup>. Based on availability of trained personnel, AdM, CrM, and PfM actions may be assigned to the On-Site organizations. The organization integrates CSMS and SDPS CIs to constitute the ECS operations environment at the DAAC. The organization also supports use of ECS computational, storage and network resources by other ECS organizations, collects data in support of Trouble Ticket investigations (cf. Section 4.3.1), and provides support and technical analyses to other organizations including external systems.

The ECS On-Site M&O Organization SW maintenance functions are:

- ECS On-Site Support for Configuration Management — coordinate usage of approved configuration management (CM) procedures with elements and external interface configuration management, ensuring that changes to software are properly documented and coordinated; provide CM services for non-ECS products such as science algorithms;
- ECS On-Site Database Administration — maintain the data bases and structure of the integrated SDPS at each DAAC; provide data base administration support for the distributed system management center element; provide the operations interface to perform data base administration utilities such as data base backup and recovery, performance monitoring, and tuning; administer user access control and daily data base synchronization;
- ECS On-Site Development Organization Liaison — provide feedback on the performance of installed systems; coordinate future installations; support development activities such as design and document reviews; coordinate Trouble Tickets (TTs) and Configuration Change Requests (CCRs);

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<sup>2</sup>The ECS Contractor provides only System Engineering Liaison functions at ORNL. No ECS Contractor provided support functions at SEDAC.

<sup>3</sup>Not all ECS CIs will exist at each DAAC. For example, there are no ECS product generation requirements at ASF.

- ECS On-Site Planned Upgrades — support and participate in planning and implementation of upgrades to the ECS;
- ECS On-Site Quality Assurance — perform Quality Assurance (QA) audits on a periodic basis to ensure adherence to established standards and procedures for software;
- ECS On-Site Resource Control — maintain and modify dynamic software system configurations;
- ECS On-Site Software Maintenance — produce, deliver, and document corrections, modifications, and enhancements made to ECS software, and/or adapt or incorporate any COTS software for ECS use; and
- ECS On-Site Test and Integration — feature and regression test all system upgrades in center environment; maintain and update test procedures and data bases; support testing and benchmarking of science algorithms.

#### **4.2.3 ECS SMC Maintenance and Operations**

The SMC M&O organization provides personnel, tools, computational, storage and network resources for PvM actions on CSMS SW CIs used in the SMC operational environment. Based on availability of trained personnel, AdM, CrM, and PfM actions may be assigned to the SMC organization. The organization also supports use of SMC computational, storage and network resources by other ECS organizations, collects data in support of TT investigations, and provides support and technical analyses to other organizations including external systems.

SMC's SW maintenance functions are:

- ECS SMC Configuration Management — maintain the ECS system configuration baseline and documentation library; coordinate system-level upgrades and adjust baselines as required in conjunction with DAAC configuration managers;
- ECS SMC Database Administration — maintain the data bases and structure of the SMC database; provide database administration support for system-wide data bases maintained at the SMC; provide the operations interface to perform data base administration; administer utilities such as data base backup and recovery, performance monitoring, and tuning; administer user access control and daily data base synchronization;
- ECS SMC Development Organization Liaison — provide feedback on the performance of installed systems; coordinate future installations; support development activities such as design and document reviews; coordinate TTs and CCRs;
- ECS SMC Planned Upgrades — support and participate in planning and implementation of upgrades to the ECS;
- ECS SMC Quality Assurance — perform QA audits on a periodic basis to ensure adherence to established standards and procedures for software;



- ECS SMC Software Maintenance — produce, deliver, and document the corrections, modifications, and enhancements made to ECS software; adapt or incorporate any COTS software for ECS use; and
- ECS SMC Test and Integration — feature and regression test all system upgrades in SMC environment, either hardware or software; maintain and update test procedures and data bases.

#### **4.2.4 ECS EOC Maintenance and Operations**

The EOC M&O organization provides personnel, tools, computational, storage and network resources for PvM, AdM, CrM and PfM actions on FOS SW CIs. The EOC M&O organization integrates and performs PvM actions on CSMS SW to constitute and maintain the EOC operational environment. Based on availability of trained personnel, AdM, CrM, and PfM actions may be assigned to the EOC organization. The organization also supports use of EOC computational, storage and network resources by other ECS organizations, collects data in support of TT investigations, and provides support and technical analyses to other organizations including external systems.

The Mission Operations Manager will authorize directed software maintenance activities in support of Instrument Support Terminals. The SMC will be authorized to distribute applicable changes and maintenance documentation.

SW maintenance functions are:

- Configuration Management — employ approved configuration management procedures with element and external interface configuration management; ensure that software changes are properly documented and coordinated; assist in the development and administration of the EOC library with respect to configuration management procedures;
- Database Administration — maintain and enhance flight and ground systems database;
- Ground Segment Development — support ground system development, testing and provide critiques;
- Software Maintenance — maintain and enhance the flight and ground systems database, firmware, and software; and
- Integration and Test — feature and regression test all system upgrades in center environment, either hardware or software; maintain and update test procedures and data bases.

#### **4.2.5 ECS Sustaining Engineering Office (SEO) Maintenance and Operations**

The ECS SEO organization, housed at GSFC Building 32, provides a system-wide SW maintenance function for CSMS and SDPS SW to minimize operation and maintenance problems, schedule release installation, solve inter-site operations problems, and lead

efforts to resolve any operational system problems. Where the ECS On-Site, ECS SMC, and ECS EOC M&O organizations are focused on the issues, tasks and priorities of the individual centers, the ECS SEO provides a system perspective on maintenance. Supported by the other M&O organizations, the ECS SEO organization also provides the focus for development organization interactions as mediated by the ESDIS CCB Technical Review Board (TRB) whose role is elaborated in the ESDIS Configuration Management Plan (May 1995 Draft). ECS system-level maintenance actions are approved by the ESDIS CCB. The TRB will have representatives from development and operations as well as other contractors as required to mediate technical issues. This management structure is supported by the hierarchy of CCBs shown in Figure 4-3.

The SEO M&O organization provides personnel and tools while utilizing the local site's computational, and network resources for AdM, CrM and PfM actions for CSMS and SDPS SW CIs. PvM actions for maintenance of the master M&O baseline and backups are the responsibility of the SEO. Based on availability of skilled personnel, additional PvM actions may be assigned to the SEO. Use of computational, storage and network resources at the DAACs, SMC, and EOC are coordinated with the appropriate ECS organization.

SEO's SW maintenance functions are:

- ECS Configuration Management — provide M&O centralized CM functions in support of other centers' distributed CM functions and responsibilities; prepare appropriate Configuration Change Requests (CCRs) in support of maintenance actions; coordinate usage of approved configuration management procedures with elements and external interface configuration management; ensure that changes to the software and procedures are properly documented, coordinated and distributed; assist in the development and administration of the library for CM procedures; establish and manage library backups;
- ECS Database Administration — provide system-level engineering on science data base classes/servers; supports needs of ECS On-Site data base administration;
- ECS Development Organization Liaison — provide feedback on the performance of installed systems; coordinate future installations; support development activities such as design and document reviews; coordinate Trouble Tickets and CCRs;
- ECS Planned Upgrades — support and participate in planning and implementation of upgrades to the ECS;
- ECS Quality Assurance — monitoring, inspection and analysis of ECS functions, procedures, equipment, personnel, and data assets;
- ECS Software Maintenance — accept and integrate maintenance changes to ECS software produced at one (or more) of the DAACs, SMC or EOC; produce, deliver, and document system-wide corrections, modifications, and enhancements made to ECS software, and/or incorporate any COTS software for ECS use; and
- ECS Test and Integration — feature and regression test system-wide upgrades, either hardware or software prior to shipment to other centers; maintain and update test procedures and data bases.

#### **4.2.6 ECS ILS Maintenance and Operations**

The ECS ILS M&O organization is responsible for system maintenance of COTS SW CIs as described in the COTS Maintenance Plan (613-CD-001-001). Integration of COTS CIs with developed SW CIs is a joint responsibility of all ECS M&O organizations.

### **4.3 Policies and Procedures**

The plan for implementation of prioritization, problem escalation, and resolution procedures are discussed. Responsibility for these actions is discussed in the context of available information and is an appropriate level of detail for this document. Implementation is not ad hoc. ESDIS will review and refine this process by assigning specific responsibilities that are determined during implementation. The SEO and the site-level maintenance organization resolve routine maintenance issues at the system-level and site-level, respectively, using the Trouble Ticket System for making temporary maintenance changes, which are recorded in the Baseline Manager tool (cf. Section 3.2 and the M&O Configuration Management Plan (102-CD-002-001)). A Government sponsored Failure Review Board will also approve priority level 1 and 2 issues (cf. Section 4.1). The Change Control Board process will approve all permanent changes (cf. Sections 4.3.4, 4.3.5 and the M&O Configuration Management Plan (102-CD-002-001)).

#### **4.3.1 Trouble Tickets**

TTs are used to describe and document problems with release CIs. They can be generated by operations, maintenance, development, and customer personnel as well as users. TTs are handled through a common distributed access database system.

TTs are first evaluated at the local centers to determine the severity of the problem and assignment of on-site responsibility/cognizance. Every TT is still logged into the database for record keeping purposes. TTs that can be resolved locally are assigned and tracked at the local center. Matters of sufficient importance are escalated to the TT Telecon agenda for further discussion and disposition by the Failure Review Board.

TTs are discussed at a weekly TT Telecon. This meeting functions as the ECS Failure Review Board (FRB) in compliance with the EOS Performance Assurance Requirements for ECS, GSFC 420-05-03, Section 7.12.2.2 and is held to synchronize and coordinate TT activities within the M&O organization as well as with development, customer, and user organizations.

Attendees include:

- Customer representatives;
- ECS SEO engineering teams leads (one is designated as chairperson of the meeting);
- ECS ILS engineering support;
- Via telecon, ECS engineering team leads and operations representatives;

- ECS M&O support staff;
- ECS development organization representatives (including management, technical, configuration management and quality assurance); and
- SCF(s) representatives (in person or via telecon).

A typical agenda is shown by Figure 4-2. Agenda items may be supplemented or replaced by hardcopy or softcopy reports. Material from this meeting is distributed within each ECS organization and to customer and user organizations as required.

<p><u>TT Discussion</u></p> <ul style="list-style-type: none"> <li>• Review and prioritize each TT opened at each center</li> <li>• Review and re-prioritize older TTs (as required)</li> <li>• Assign TT work-off responsibility to one organization</li> <li>• Review distribution of TTs by organization, priority and age</li> <li>• Discuss TT issues with development organizations</li> </ul>
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***Figure 4-2. Typical TT Telecon Agenda***

### **4.3.2 Investigation of Anomalies and Inefficiencies**

Anomalies, the apparent incorrect execution of an ECS CI, and inefficiencies, sub-optimal use of system resources, are documented using TTs. A TT may be submitted by users, operations, customer, analysis, maintenance and management staff. At the time of TT submittal, supporting information and data is captured by the ECS staff.

At the TT telecon, the TT is prioritized and assigned by the FRB to an organization for work-off. A Responsible Engineer (RE) is assigned to work-off the TT. Using the captured data, a technical investigation is performed to attempt to isolate the source of the reported anomaly or inefficiency.

If the problem is caused by a non-ECS element (e.g., an interface problem with an external system, poor resource usage by a science algorithm, poor performance by a non-ECS service, etc.), the TT and supporting material is provided to the maintainer of that element. An ECS Configuration Change Request (CCR) may also be proposed to protect ECS from potential threats of future problems identical or similar to that documented in the TT. CCRs are discussed in detail at Section 4.3.4.

If the TT is properly against an ECS element, one or more of the following actions are taken:

- Describe the source of the problem and the recommended design/implementation change. Procedure modifications may also be appropriate.

- **Modify procedures.** Describe the source of the problem and modify procedures to eliminate or reduce the number of occurrences of the documented problem. Modifications may be temporary (i.e., work-arounds) or permanent. If the change is permanent, the TT can be closed and/or a User Recommendations Data Base (URDB) input generated.
- **Track.** The technical investigation focuses on collection of additional data from new occurrences to support additional analyses into the root of the problem and/or the frequency of occurrence. As a result of tracking, further technical investigations may result in any of the other actions.
- **Re-prioritize.** Describe the results of the technical investigation and recommend a priority change at the TT Telecon. A lowered priority may result in the TT going into backlog status or being closed. A higher priority may result in additional resources being applied to the technical investigation.
- **Close with URDB input.** The technical investigation may discover that what is being reported as a problem is actually the proper implementation of the feature based on the requirements baseline. A URDB input documents a recommended requirements change.
- **Close TT into existing TT or CCR.** If the TT documents a known problem for which no solution has been identified, the new TT can be closed into the existing TT. Supporting material from the new TT is added to that previously collected. The TT may also be closed into a CCR that has been previously written but not yet installed into the operational baseline.

The originator of the TT is kept informed throughout the process via minutes from the TT telecon and voice/e-mail status reports from the RE.

### **4.3.3 Operational Work-Arounds**

TT resolution may result in temporary modifications to operations and user procedures. Operational work-arounds are managed by the ECS Operations Supervisor at each center. A master list of work-arounds and associated TTs and CCRs is kept in either hard-copy or soft-copy form for the operations staff. Hard-copy and soft-copy procedure documents are “red-lined” for use by the operations staff. Work-arounds affecting multiple sites are coordinated by the ECS organizations and are monitored by the ECS M&O Office staff.

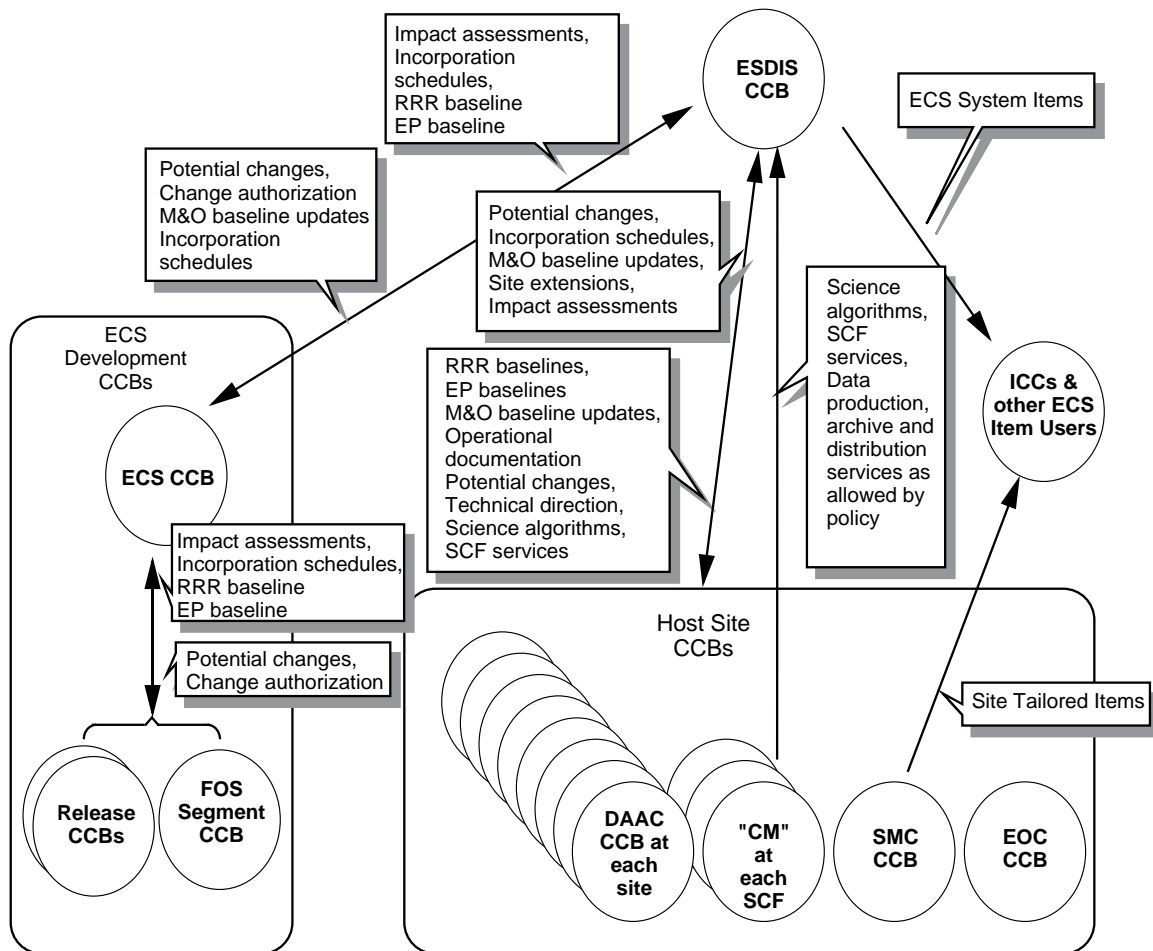
System Releases affecting multiple sites will factor into the requirements baseline any required changes for specific sites and will be timed to allow integration and acceptance testing at local sites. ESDIS will have the discretion to alter delivery schedules to meet emergencies, contingencies, and/or ECS program objectives in a timely manner.

The work-around is removed when the CCR that corrects the original problem is installed into the operational baseline.

Work-around status and metrics are tracked at the Site/Center and M&O System weekly meetings (see Appendix B of Maintenance and Operations Management Plan).

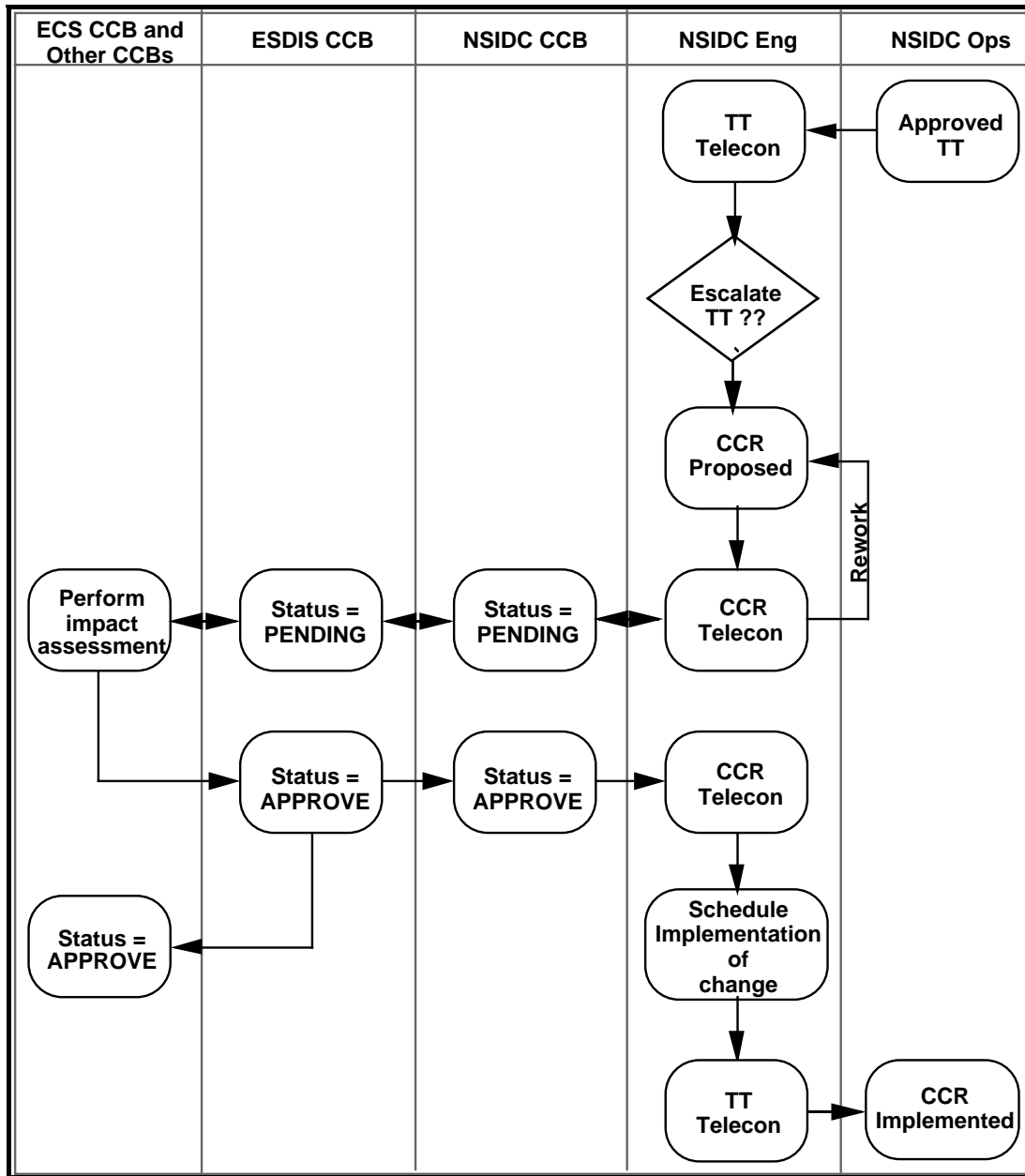
#### 4.3.4 Presentations to Configuration Management Board

There are multiple levels of configuration management within the ECS Project as illustrated in Figure 4-3. Operational center-level and ECS CCBs interact directly with the ESDIS CCB. The ECS Release CCBs (one for each ECS Release) and the FOS CCB manage installation and changes at each location prior to RRR under the governance of the ECS CCB and, as necessary, the ESDIS and host center CCBs. The ECS M&O organization at each center does not constitute a CCB but, rather, supports the host organization's CCB. Appendix A of the Maintenance and Operations Management Plan provides additional detail on these boards.



**Figure 4-3. CCB Relationship**

In accordance with the ESDIS Distributed Active Archive Center (DAAC) Strategic/Management Plan, the ESDIS CCB provides configuration control over all ECS developed SW CIs following RRR. Figure 4-4 shows the flow of a TT and related CCR through the various CCBs and the Telecon using a TT generated at NSIDC as an example. An annotated scenario is provided in Appendix B of the Maintenance and Operations Management Plan.



**Figure 4-4. CCR Approval Scenario**

The following information is typically provided for each CCR at each CCB:

- Description of the problem;
- Description of the recommended solution;
- Impact assessments (summary and detailed, as required);
- Estimated cost (work-hours and/or ODC);

- Recommended priority;
- Recommended scope (DEVELOPMENT, M&O, DEVELOPMENT\_AND\_M&O, DAAC\_UNIQUE, SMC\_UNIQUE, or EOC\_UNIQUE);
- Recommended organization (DEVELOPMENT\_office, M&O\_organization);
- Recommended incorporation schedule; and
- Actions by other CCBs.

### **4.3.5 Implementation of Modifications**

Multiple baselines may exist throughout the ECS contract. After the Release A, it is possible that the M&O organization will need to modify the configuration as established at each center. To support this need, the SEO acts as the configuration manager for the M&O master library. Copies of this library are distributed to each center to provide both a distributed backup and local availability of the library. This is the same library delivered by the release development organization at RRR. The governing policies and minimum developed software component level that may be removed or reintroduced (checked-out for maintenance) from the ClearCase (SW Change Manager) master library are defined by the developers determination of code modules. This topic will be detailed in the description of the SW Change Manager and Baseline Manager tools part of the SMC design. SW changes are distributed on the basis of SW Configuration Items to the sites' copy of the SW Change Manager and recorded in the sites' copy of Baseline Manager following configuration management procedures defined in the prior referenced M&O CM Plan (102-CD-001-002) and the M&O Procedures (611-CD-001-001).

Implementation of changes is performed using a controlled build procedure. For each build, each ECS organization selects an RE. The SEO RE establishes the set of CCRs included in the system build. The ECS On-Site, SMC and EOC REs determine which, if any, site-unique extensions are to be applied to the system build. Schedules for implementation, integration, and test at the system and center levels are established. The SEO RE maintains the integrated system and center-specific CCR list and schedule.

The SEO RE maintains the Version Description Document (VDD) that contains:

- The CCRs incorporated into the build and their operational and/or user features;
- The build schedule;
- ECS external interfaces affected by the build;
- ECS CIs affected by the build;
- List of ECS documentation (e.g., design documents, procedures, help files, etc.) affected by the build;
- Test program results summary; and
- Test team recommendation.



The initial VDD is provided at RRR by the Independent Acceptance Test Organization. It is then maintained by the Sustaining Engineering Office (SEO) as described in Sections 4.3.6 and 4.3.7. It contains not only the as-built documentation, but is supplemented by the as-tested, verified, and accepted documentation as discussed in the Acceptance Testing Management Plan. The document is described in the System Implementation Plan for ECS Turnovers (ECS 301-CD-003-001) which addresses the overall ECS system turnover process (HW, SW, and documents). The SEO RE updates depend on authorized changes.

Appendixes are added as necessary to the system level VDD by each center's RE to describe any center-unique additions/modifications to the build. The VDD is published in draft form well in advance of the build using ECS bulletin boards and electronic distribution. Updates are published as information is gathered. The final VDD is published just prior to installation of the new build into operations.

For a given CCR, the RE (or team) to whom implementation of the CCR is assigned uses the configuration controlled local library to obtain the correct version of the source code/files. Using ECS provided editors, compilers, and build procedures, the RE implements the change, performs programmer testing, and updates the documentation including design, interface, and procedure documents.

The RE may discover that the approved incorporation schedule can not be met because of unforeseen complexity, changes in priority, or conflicting assignments. Revised implementations, priorities and schedules are brought to the CCR Telecon for discussion. If necessary, a revised CCR and/or incorporation schedule is forwarded to the ESDIS CCB for impact assessment. Typical CCR discussion topics are outlined in Figure 4-5.

<p><u>CCR Discussion Topics</u></p> <ul style="list-style-type: none"><li>• Review and prioritize each CCR opened at each center</li><li>• Review and re-prioritize older CCRs (as required)</li><li>• Review status of open CCRs</li><li>• Review distribution of CCRs by organization, status, priority and age</li><li>• Recommend new/revised assignments of CCRs to organizations/centers</li><li>• Discuss CCR issues with development organizations</li></ul>
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***Figure 4-5. Typical CCR Telecon Agenda***

Upon completion of the modification, the revised source files, data bases/structures, and documentation are impounded and controlled by the Integration and Test organization at the RE's site using the CM tool. The impounded material is forwarded (if developed at a DAAC, the SMC or EOC) to the SEO for system integration and test. In the case of FOS SW CIs, system integration and test is performed within the EOC.

The golden copy of ECS SW is maintained by SMC. Required access to the golden copy as well as changes will be guaranteed by logging changes and backup of modifications for later access as required by users, developers, and maintenance personnel under CM guidelines delineated by the ECS CM Plan. SW will also be maintained by local CM at the DAACs.

#### **4.3.6 Test Plans and Procedures**

The objective of the test program is to ensure that the CCRs are properly implemented and that defects have not been introduced as a result of the changes. Therefore, both feature (has the CCR been properly implemented) and regression (revalidation of proper operation of the CI and system) testing at both the system and center levels are critical parts of the test program.

The test function exists within each of the M&O organizations. In the larger organizations, individuals may be dedicated to testing of M&O builds. In the smaller organizations, testing may be performed by personnel who have additional assignments. Regardless, the guiding principle is that the maintenance programmer who made a change is not allowed to be the only person who revalidates the program or provides feature testing.

The methodology employed in testing includes:

- Inspection — formal verification by examination of the assembled CI and its design documentation;
- Analysis — formal verification by examination and study of the CI/data base/data structure design and coding;
- Demonstration — formal verification by operating the computer program; and
- Review of test data — review of test records and data after the execution of the computer program.

These are categories of testing procedures. The specifics can not and should not be pre-determined, but rather should be responsive to the individual requirements determined by the extent/impact of changes made to the original CI. M&O testing shall consist of recreating in whole or in-part the same scenarios used in the original acceptance testing.

Using the information in the Version Description Document (VDD) described in Section 4.3.5, the system and center test teams develop test plans for the build. The plans describe the following items that are to be used for both feature and regression testing:

- The CCRs to be tested;
- The CM baseline(s) to be used;
- The requirements and features to be verified;
- The method of verification including identification of test cases/data sets;
- Acceptance criteria;
- Resource requirements; and
- Schedule of testing.

Test procedures provide the detailed scenarios and test cases/data sets, steps, operator/user actions, analyses, etc., that implement the test plan.

Feature testing is performed through either the development of new test cases and data or the modification of existing test cases and data. Regression testing is performed using standard test cases with expected test results. When possible, the same test cases and data as were used when the program was originally developed are used. Test cases developed for prior feature testing are also used as part of the test program.

When possible, center-specific testing of system-level change builds will be performed in conjunction with the system test. If this is not possible, center-specific testing will precede the system level testing to allow a controlled increase in complexity during the test program. Should center-specific modifications to the system build be required, center level testing will be performed at the center first and then included in either the initial or follow-on system-level testing.

Test results and analyses are developed by the test organization(s) are provided to the SEO and center REs. Unacceptable performance during the test program may result in delaying of the entire build or removal of a CCR from the build. Because the test team functions as an independent assessment of the build, it provides its recommendation on the quality and performance of the build to the SEO. A summary of the test program and the test team's recommendation are added to the VDD.

The SEO RE is responsible for review of the test plans and procedures to ensure the adequacy of the test program. Center REs support the SEO RE in this assessment. Status of the test program is also provided to ECS and center management at the weekly status meetings described in Appendix B of the Maintenance and Operations Management Plan.

#### **4.3.7 Installation**

The Version Description Document (VDD) provides the summary documentation package for each build. The material in the VDD is presented by the ECS M&O test function to the appropriate individual(s) within ESDIS. The VDD material is also presented by the ECS M&O test organization to the appropriate individual(s) within each operational center. If required by ESDIS or the center, results of IV&V or center-unique testing results will be presented by the appropriate organization. Upon review and approval by ESDIS and center management, the build as baselined in the center-specific VDD is authorized for system-wide and center operations.

The following sequence then occurs:

- The VDD undergoes final updates for system and center-specific material identified by ESDIS or the operational centers (e.g., IV&V test results and recommendations, center by center operational installation schedule, etc.).
- The final VDD is published.
- In accordance with the installation schedule, the build is installed at each center along with operational and user documentation updates.

- Controlled Document updates are provided to Document Maintenance and entered into the CM system.
- The CM system is updated to indicate the M&O system and center-specific baselines.

#### **4.3.8 Operations and User Notification**

The Version Description Document (VDD) is the vehicle for communicating the contents, status, feature, schedule, and test results to the ECS stake holders. It is supplemented by test plans, test procedures and test results. Draft and final versions of the VDD and test program documentation are published and distributed to interested organizations internal (e.g., the ECS Development Offices, System Management Office, Quality Office, Science Office, etc.) and external (e.g., ESDIS, DAAC, other Customer, external systems, IV&V contractor, SCFs, user groups, etc.) to the ECS Contractor using ECS bulletin boards and electronic distribution.

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# Abbreviations and Acronyms

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AdM	Adaptive Maintenance
A <sub>o</sub>	Operational Availability
ASF	University of Alaska Synthetic Aperture Radar (SAR) Facility
CCB	Configuration Control Board
CCR	Configuration Change Request
CDR	Critical Design Review
CDRD	Contract Data Requirement Document
CDRL	Contract Data Requirements List
CI	Configuration Item
CM	Configuration Management
COTS	Commercial Off-the-Shelf
CrM	Corrective Maintenance
CSMS	Communications and Systems Management Segment
CSS	Communications subsystem
DAACs	Distributed Active Archive Centers
DID	Data Item Description
DM	Data Management
DR	Discrepancy Report
ECS	EOSDIS Core System
EDC	Earth Resources Observation Systems (EROS) Data Center
EDF	ECS Development Facility
EOC	EOS Operations Center
EOS	Earth Observing System
EOSDIS	Earth Observing System (EOS) Data and Information System (DIS)
EROS	Earth Resources Observation Systems
ESD	Electrostatic Discharge

ESDIS	Earth Science Data and Information System (GSFC Code 505)
ESN	EOSDIS Science Network
FMEA	Failure Modes, and Effects Analyses
FOS	Flight Operations Segment
GFSC	Goddard Space Flight Center
HW	Hardware
IDR	Increment Design Review
ILS	Integrated Logistics Support
ILSO	Integrated Logistics Support Office
IMS	Information Management System
ISS	Internetworking Subsystem
IST	Instrument Support Toolkits
JPL	Jet Propulsion Laboratory
LaRC	Langley Research Center
LORA	Level of Repair Analysis
LRU	Line Replaceable Unit
LSA	Logistics Support Analysis
M&O	Maintenance and Operations
MOMP	M&O Management Plan
MR	Malfunction Report
MSFC	Marshall Space Flight Center
MSS	Management Subsystem
NA	Network Administrator
NASA	National Aeronautics and Space Administration
NSIDC	University of Colorado, National Snow and Ice Data Center
OEM	Original Equipment Manufacturer
OPPM	Outside PPM Hours
ORNL	Oak Ridge National Laboratory
PAIP	Performance Assurance Implementation Plan

PfM	Perfective Maintenance
PHS&T	Packaging, Handling, Storage, and Transportation
PM	Preventive Maintenance
PPM	Principal Period of Maintenance
PvM	Preventive Maintenance
RMA	Reliability, Maintainability, and Availability
SA	System Administrator
SAR	University of Alaska Synthetic Aperture Radar
SDPS	Science Data Processing Segment
SEO	Sustaining Engineering Office
SMC	System Monitoring and Coordination Center
SOW	Statement of Work
SW	Software
TT	Trouble Ticket
URDB	User Recommendations Database



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